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| List of attachments: | | | |
| (1) Detailed descriptions: | 1 copy | | |
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(54) HEAT-RESISTANT MULTILAYER WOVEN MATERIAL

Figure 1

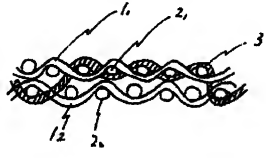
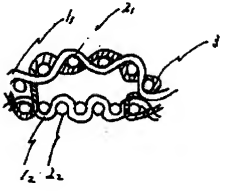



Figure 2



## CLAIM

A heat-resistant multilayer woven material characterized by the fact that it consists of connecting the surface-side first layer, containing heat-resistant polymer fibers, for example, heat-resistant fibers made of more than 60% aromatic polyamide with a textured structure, and the second layer having a thermal-shrinkage ratio higher than that of the first layer, containing more than 50% synthetic fibers, as well as having a textured structure, or the second layer and layers under this; furthermore, the second layer (or the second layer and layers under it) are subjected to more thermal shrinkage than that of the first layer, and spaces are generated between the first layer and the second layer.

## BRIEF EXPLANATION OF THE FIGURES

The figures are cross-sectional diagrams of the woven material of the implementation embodiment of the present design. Figure 1 is the material before the heat treatment, and Figure 2 is after the heat treatment.

## DETAILED EXPLANATION OF THE DESIGN

The present design relates to the structure of the heat-resistant multilayer woven material for use in fire-preventive, heat-resistant clothing, for racing cars or other racing clothes and so on.

Its objective is to provide a multilayer woven material that not only has very high heat resistance and adiabatic effect but is also very soft, and when used in fire-preventive, heat-resistant clothing, feels good when worn despite its thickness, is high in operability and mobility, and has the same characteristics even when used for racing cars or other racing clothes.

The use of the multilayer woven material in the conventional applications mentioned above has been widely known from Japanese Utility Patent No. Sho 43 [1968]-24546. However, since this constitutes nothing but being woven in a multilayer form with heat-resistant fibers, the heat resistance and adiabatic effect have been insufficient.

The present design eliminates such a disadvantage. It is in essence a heat-resistant multilayer woven material characterized by the fact that it involves connecting the surface-side first layer, containing heat-resistant polymer fibers, for example heat-resistant fibers of more than 60% aromatic polyamide with a textured structure, and the second layer having a thermal-shrinkage ratio higher than that of the first layer, containing more than 50% synthetic fibers, as well as having a textured structure, or the second layer and layers under this; furthermore, the second layer (or the second layer and layers under this) are subjected to more thermal

shrinkage than that of the first layer, and spaces are generated between the first layer and the second layer.

If the present design is explained with attached diagrams, ($1_1$) is the longitudinal yarn which forms the texture of the surface-side first layer, and ($2_1$) is the latitudinal yarn with the same texture.

($1_2$) is the longitudinal yarn which forms the second layer, and ($2_2$) is the same latitudinal yarn. Furthermore, (3) is the connecting yarn.

The first-layer longitudinal yarn ($1_1$) and latitudinal yarn ($2_1$) are yarns containing asbestos, metal fibers, glass fibers or other heat-resistant, inorganic fibers, Nomex (a heat-resistant nylon commercial trademark name of U.S. DuPont Co.) or other heat-resistant synthetic fibers; that is, more than 60% thermally excellent fibers (preferably 100%). Any spun yarns or filament yarns can be used.

The second-layer longitudinal yarn ($1_2$) and latitudinal yarn ($2_2$) consist of, for example, filament yarns, 100% spun yarns, or mixed spun yarns of polyester fibers, and so on. When carrying out the heat treatment, conditions resulting in a higher shrinkage ratio than that of the longitudinal and latitudinal yarns of the first layer are required.

The inorganic fibers and the heat-resistant fibers of the first layer are excellent in stability with respect to heat. The boiling-water shrinkage ratio is about 0%, and the shrinkage ratio at dry heat of 200°C is also about 0%.

On the other hand, for the second-layer synthetic fibers, those having a high boiling-water shrinkage ratio and dry-heat shrinkage ratio are used. Thus, by carrying out a heat treatment to create a difference in thermal-shrinkage ratios between the first layer and the second layer, the second layer underneath is shrunk. As shown in Figure 2, a space is made between the first layer and the second layer to render an adiabatic effect.

It is preferable that the connecting yarn is made of heat-resistant fibers. However, it is not restricted to this.

It is desirable that the shrinkage-ratio difference between the first layer and the second layer is more than 3%. In this case, the heat treatment is carried out by boiling-water treatment or dry-heat treatment.

The connecting points, for connecting the first layer and the second layer, are more than 2 [illegible] to facilitate the formation of the space.

The present design is constituted in the manner described above. As a result, the following effects can be achieved.

(1) Since the surface-side first layer is made of heat-resistant fibers, it goes without saying that it has a fire-preventive, heat-resistant effect. Furthermore, if it is woven in such a texture [illegible] to a considerable extent, the flow of heat is prevented and said effect is increased. Moreover, in addition to this, the texture for the formation of the bottom-side layer of the multilayer woven material creates a space between the side layers by heat treatment. The air between the first layer and the second layer further increases the adiabatic effect.

(2) Both layers on the surface side and the back side are characterized by texture. Thus, the stiffness of both sides maintains an appropriate balance. Furthermore, since a space exists between the two layers, if it is used as fire-resistant clothing, the body will be covered [illegible] in an appropriate manner from the body. A good space is formed between the clothes and the body. It is free from causing hot [illegible] clothing. From the perspective of safety as well, extremely beneficial results are obtained.

(3) When necessary, if a fiber-creating process is carried out on the back side, the adiabatic effect can be further increased.

The present design is not simply restricted to two-layer weaving. Three-layer or multilayer weaving is also included.

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